PROJECT TITLE	:	INSTRUMENTATION AND PROCESS AUTOMATION
PERIOD COVERED	:	JANUARY 1981
WRITTEN BY	:	M. THEVOZ

The configuration described previously[1] is now being used to carry out a more extensive study. This survey covers different topics all concerning NO_3 electrode drift and response in standard solutions as well as in raw tobacco extracts. The microcomputer used in this survey for controlling the process was a HP 85 desk top and had a 16 K memory extension. It was also fitted with the following two interface cards :

- GPIO (General Purpose Input-Output)

  This card senses different digital input signals and drives the different power lines which are connected to the pump and magnetic valves.

- BCD (Binary Coded Decimal)

  This card provides a flexible means of communication between instruments offering parallel-digital outputs.

The main programme being tested at the present time is written in BASIC and uses the powerful I/O statements specially developed for this desk-top computer. Using the first version of the process control programme particularly designed for laboratory use, the following operations were able to be performed :

- A complete, automatic cycle of calibration and measurement of the ion-analyser;

- Selection of a pre-defined sampling rate; input of all process parameters with off-range detection;

- Dispensation of the amount of sugar in the fermentor computed in relation to the NO_3 concentration of a raw extract;

- Generation of a print-out for calibration and NO_3 data points;

- Automatic output of statistical results (minimum, maximum, standard deviation, coefficient variation %) every hour, day and week during the duration of the experiment;

- Setting-off of an acoustic alarm generated by the microcomputer for indicating different off-range values or abnormal operations detected during regulation;

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- Display of three different graphic screens. These screens may be selected by external adjustment of a digital pre-selector. Each screen continually gives information on the electrode drift and NO_3 concentration of the extract as a function of the time elapsed;

- Automatic up-dating of the scale of each graphic representation according to the number of measurements recorded;

- Automatic transfer of graphic data onto the thermal printer once the screen is full;

- Display of sugar consumption at each sampling interval, hour, day and week during the duration of the experiment;

- Display of the minimum and maximum values of the standard and the extract in the last hour or day of operation.

The basic regulation principle involves the following factors :

The NO_3 concentration in the raw extract is measured at a pre-selected sampling rate ranging from 5 to 27 minutes depending on the type of experiment being performed. Before any measurements are taken, the electrodes are automatically re-calibrated with a 10 ppm NO_3 standard. Sugar is dispensed into the fermentor at a constant flow rate. The pump is fed by a 2-way magnetic valve connected to two different sterile containers. One of these containers is filled with a 40% glucose solution and the other with distilled water. The tube to the sugar container is open for a limited amount of time and this is controlled by the computer. The length of time depends on the NO_3 level of the incoming raw extract.

The total opening time is divided up into sampling intervals, ie the valve is alternatively opened and closed and this ensures a homogenous distribution of the sugar. Figure 1 presents the principle of this dispensing mode.

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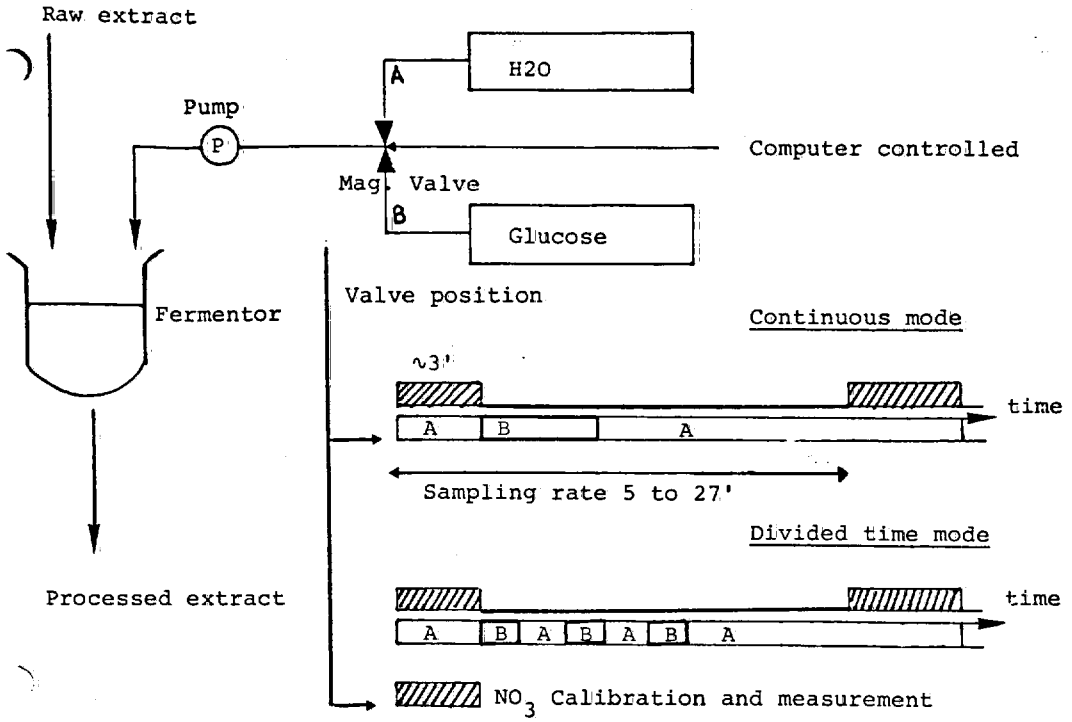

Figure 1 : Sugar dispensing mode

Different experiments are being carried out to test this type of NO_3 monitoring and to evaluate the different problems arising as regards electrode stability in a diluted tobacco extract. The power module which operates the different valves and pumps uses opto-relays which greatly reduce the electrical interference.

The flexible and powerful HP 85 machine enables rapid development (about 15 working days) for small process controls.

(1) Monthly Report of August 1980

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